

Research Article

Clinical and Etiological Characteristics and the Diagnostic Value of Laboratory Tests in Hemodialysis Patients with Infections at the Donka National Hemodialysis Center

Fousseny Diakite^{1,2,*} , Ibrahima Bah^{1,3}, Soriba Bangoura^{1,2},
Amadou Yaya Diallo^{1,2}, Fatoumata Kaba², Fara Andre Sandouno²,
Alseny Mariame Camara², Mamadou Malal Diallo²,
Kadiatou Mamadou Bobo Barry^{1,2} , Aly Traore^{1,2},
Mohamed Lamine Tegui Camara^{1,2}, Damaris Yawa Leno²,
M'ballou Fatoumata Bangoura², Alpha Oumar Bah^{1,2}

¹Faculty of Health Sciences and Technology, Gamal Abdel Nasser University of Conakry, Conakry, Guinea

²Nephrology and Hemodialysis Department, Donka University Hospital, Conakry, Guinea

³Department of Infectious and Tropical Diseases, Donka University Hospital, Conakry, Guinea

Abstract

Introduction: Infections are the leading causes of morbidity and mortality among hemodialysis patients, and low socioeconomic status makes their management extremely complex. The objective of this study was to determine the frequency of the identified causes of infection and to report the role of each laboratory test in the diagnosis of infections. **Patients and Methods:** Our descriptive, prospective study was conducted from February 1 to July 31, 2025. Included were all hemodialysis patients, regardless of the type of extracorporeal renal replacement therapy, in whom the diagnosis of infection was established based on clinical evidence (functional, general, and physical signs) and/or paraclinical evidence (biological, radiological, and morphological findings), regardless of the vascular access or site of infection. Our variables were both quantitative and qualitative and were categorized into epidemiological, clinical, and paraclinical data to determine the etiology and identify the causative microorganism. **Results:** Of the 386 patients, 145 (37.6%) were diagnosed with an infectious syndrome. The most common general symptoms were fever (94%) and chills (29%). Blood cultures were ordered for 98 patients; 54% underwent the test, and 39.6% of those tested positive. Stool culture (98 requests, 47.9% performed, and 36.2% positive); cytology (67 requests, 95.5% performed, and 20.3% positive); catheter tip culture (36 requests, 91.7% performed, and 66.7% positive); chest X-ray (60 requests, 80% performed, and 77.1% positive). **Conclusion:** Infections affect more than one-third of hemodialysis patients, particularly those on temporary dialysis, where infections are both a cause and a serious complication.

Keywords

Infections, Clinical Presentation, Etiologies, Paraclinical Findings, Hemodialysis Patients, Donka

*Correspondence: Fousseny Diakite (fdiak70@gmail.com)

Received: 2 October 2026; Accepted: 15 October 2026; Published: 31 October 2026



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1. Introduction

Infections that occur in patients with renal failure undergoing hemodialysis require immediate therapeutic management that is aggressive enough to be effective quickly. They are the second most common complication observed in hemodialysis patients after cardiovascular complications, and are generally nosocomial or community-acquired in origin, representing the leading cause of morbidity and the second leading cause of death, most often linked to the immunosuppression caused by renal failure, as well as to multiple skin entry points, the hemodialysis unit environment—which is conducive to infection risk—and the treatments administered [1, 2]. In addition to intra-individual transmission, infectious agents can be transmitted from patient to patient, either directly or indirectly, via medical devices or contaminated surfaces, or through the contaminated hands of staff [3]. Hemodialysis patients often develop infectious complications due to implanted catheters. The use of a hemodialysis catheter is associated with an eight-fold higher rate of bloodstream infections related to vascular access compared to an arteriovenous fistula (AVF). Infectious complications include bacteremia and exit-site infections, the majority of which occur in dialysis patients with central venous catheters (CVCs) [4]. Central venous catheter infections are also associated with other complications, such as endocarditis, epidural abscess, and arthritis. Central venous catheter-related sepsis is responsible for increased morbidity and mortality. Reporting of bloodstream infections among outpatient hemodialysis patients may be compromised by methodological challenges. Patients who become symptomatic with fever or chills often present directly to the hospital rather than to the hemodialysis center [5]. The prevalence of infection among dialysis patients is 42.4% in the United States [6]. In France, a study of 1,455 hemodialysis patients found that the frequency of infectious episodes was 39% [7], with the main types of infections being pneumonia, vascular access infections, urinary tract infections, and viral hepatitis B and C.

In Brazil, Schwanke AA et al. [8] reported in a study of 69 hemodialysis patients that the incidence of infection was 9.1%, and the risk factors were length of hospitalization and catheter insertion into the left femoral vein.

In Poland, Krzanowski M et al. [9] conducted a study of 213 hemodialysis patients, of whom 181 had arteriovenous fistulas; 28 had permanent catheters and 4 had arteriovenous grafts. Infections were observed in 14.3% of patients with central venous catheters (CVCs), in 2.2% of patients with arteriovenous fistulas (AVFs), and in 50% of patients with arteriovenous grafts.

In Senegal, previous studies have been conducted on chronic hemodialysis patients in Dakar, where viral hepatitis B had a prevalence of 6.7% in 2000 [10], and nasal carriage of *Staphylococcus* was isolated in 52% of patients and 24.4% of staff in 2000 [11].

In Cameroon, Fouda H et al. [12] found that, out of a total of 197 patients included in their study, the majority of patients (68.6%) had experienced at least one infectious complication,

with catheter-related infections being the most common.

Infections are the leading causes of morbidity and mortality in our hospitals, where inadequate technical facilities and low socioeconomic status are factors that make patient care extremely complex. The objective of this study was to determine the frequency of the identified etiologies and to report the contribution of each laboratory test to the diagnosis of infections.

2. Patients and Methodes

The National Hemodialysis Center at Donka National Hospital served as the setting for this study. It is the only public hemodialysis center in the entire country. It consists of two (2) dialysis rooms staffed by a multidisciplinary team of medical, technical, and hygiene personnel.

2.1. Type and Duration of the Study

This was a descriptive, prospective study lasting 6 months, from February 1 to July 31, 2025.

2.2. Target population

Our study population consisted of hemodialysis patients during the study period.

2.3. Study Population

The study population consisted of hemodialysis patients presenting with an infection at any site who were admitted to the Donka National Hemodialysis Center.

2.4. Inclusion Criteria

Our study included all hemodialysis patients, regardless of the type of extracorporeal renal replacement therapy, in whom an infection was diagnosed based on clinical evidence (functional, general, and physical signs) and/or paraclinical evidence (laboratory, radiological, and morphological findings), regardless of the vascular access or site of infection.

2.5. Exclusion Criteria

The following were excluded:

- 1) Hemodialysis patients who were being treated for HIV and viral hepatitis B and/or C.
- 2) Patients presenting with signs of infection prior to starting dialysis.

2.6. Recruitment Method

We conducted an exhaustive recruitment of all patients meeting our inclusion criteria.

2.7. Study Variables

Our variables were both quantitative and qualitative and were categorized into epidemiological, clinical, and paraclinical data, with the aim of identifying the etiology and detecting the causative microbial agent.

Sociodemographic data: These included the patients' sex, age, educational level, and place of residence.

Socioeconomic status: In our context, we considered the income of the person responsible for the patient's care (the patient themselves or a close relative).

High socioeconomic status: patients with a monthly income of $\geq$ \$700.

Medium socioeconomic status: patients with a monthly income between \$300 and \$700.

Low socioeconomic status: patients with a monthly income of \$300 or less.

Clinical data: Clinical information was collected through patient history (functional signs, general signs, and medical history) and a comprehensive physical examination to identify sites of infection: pulmonary (pulmonary consolidation syndrome); otolaryngological (rhinorrhea, otorrhea, etc.); cutaneous (purulent discharge); cerebral (Kernig's and Brudzinsky's signs); and oral.

Vascular access: routes used for extracorporeal renal replacement therapy, arteriovenous fistulas, and central venous catheters (femoral, simple jugular, tunneled jugular).

Laboratory and imaging data: Laboratory tests and medical imaging studies were ordered to confirm the infectious syndrome, identify the site of infection, and isolate the causative microorganism.

Laboratory tests: blood tests (thick blood smear, blood culture); fluid samples (urine cytology, cerebrospinal fluid, pleural fluid, gastric fluid, sputum, pus); cultures (catheter tip, stool); Medical imaging: chest X-ray (pneumonia, pleurisy, pulmonary tuberculosis), cardiac Doppler ultrasound (endocarditis), abdominal ultrasound.

Type of dialysis: The extracorporeal purification technique used was hemodialysis, which was performed on patients temporarily on dialysis (acute dialysis) and patients on permanent dialysis (chronic intermittent dialysis).

Therapeutic and clinical course data: We categorized patients according to treatment class and the antibiotics used.

In terms of clinical outcome, the two categories were: a favorable outcome (improvement in clinical status) and death.

2.8. Data Collection Techniques and Instruments

To collect data, we interviewed the patients, and the data were recorded on a pre-designed questionnaire.

2.9. Statistical Analysis of the Data

Our data were collected using a pre-designed questionnaire,

then analyzed using EPI INFO 7.4.0 software and presented using Microsoft Word and Excel from the Office 2016 suite.

2.10. Ethical and Professional Considerations

Informed consent was obtained from patients prior to their inclusion in the study. We respected the anonymity of all study participants.

3. Results

3.1. Epidemiological Data

During the study period, 386 patients were admitted for extracorporeal renal replacement therapy, of whom 80 were undergoing acute dialysis and 306 were undergoing chronic intermittent dialysis. Of the 386 patients, an infectious syndrome was diagnosed in 145 (37.6%), including 45 (31%) cases among patients admitted for acute dialysis and 100 (69%) among those admitted for chronic dialysis. [Figure 1](#).

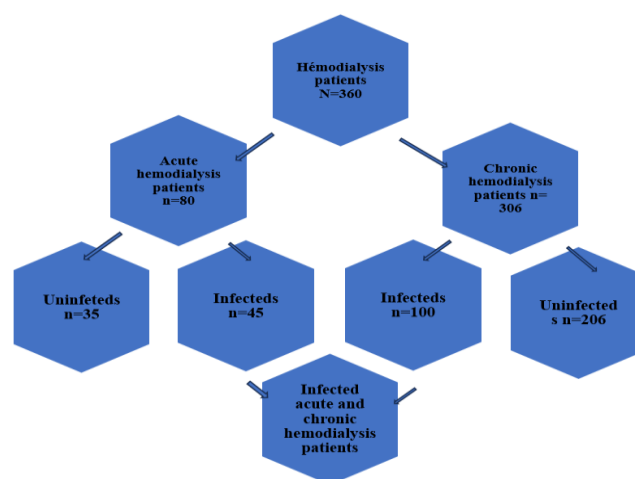


Figure 1. Distribution of hemodialysis patients by frequency of infectious syndrome at the Donka National Hemodialysis Center.

3.2. Sociodemographic Data

A predominance of males was observed (56%); patients aged 30–44 were the most affected. More than 50% had no formal education; 87% lived in urban areas; 60% had a low socioeconomic status ([Table 1](#)).

Table 1. Distribution of patients with an infectious syndrome by sociodemographic characteristics.

Variables	Sample Size (N=145)	Percentage
Gender		

Variables	Sample Size (N=145)	Percentage
Male	81	56
Female	64	44
Sex-ratio = 1,26		
Age (years)		
<29	20	14
30 – 44	46	32
45 – 54	29	20
55 – 64	32	22
65 – 74	12	08
≥75	06	04
Average age $46,65 \pm 15,33$ years extremes 14 et 80 ans		
Level of Education		
No formal education	83	57.6
Elementary school	13	9.1
High school	18	12.1
College/University	31	21.2
Place of Origin		
Rural	19	13
Urban	126	87
Socioeconomic Status		
Medium	28	19.3
Low	30	20.7
Very low	87	60

3.3. Clinical Data

Pain accounted for 93% of the functional symptoms; fever and physical weakness were the predominant general symptoms, each occurring in 93.8% of patients; and 89.6% had a central venous catheter (Table 2).

Table 2. Distribution of hemodialysis patients with an infectious syndrome according to clinical signs and vascular access.

Variables	Sample Size (N=145)	Percentage
Functional Symptoms		
Low back pain	135	93
Shortness of breath	130	90
Itching	125	86
Headache	123	85

Variables	Sample Size (N=145)	Percentage
Abdominal pain	110	76
Vomiting	104	72
Cough	103	71
Anuria	97	67
Burning sensation during urination	97	67
Itching	84	58
Chest pain	77	53
Vaginal discharge	52	36
Heart palpitations	46	32
Coughing up phlegm	45	31
Diarrhea	38	26
Frequent urination	42	29
General symptoms		
Fever	136	94
Chills	42	29
Weakness	136	96
Loss of appetite	130	90
Weight loss	81	56
Vascular Access		
Arteriovenous Fistula	15	10
Tunneled Catheter	43	30
Simple Femoral Catheter	51	35
Simple Jugular Catheter	36	25

3.4. Site of Origin of the Infection

The most commonly observed site of origin in patients was the gastrointestinal tract (67.6%; Table 3).

Table 3. Distribution of patients with an infectious syndrome by site of origin of the infection.

Entry point for the source of infection	Sample Size (N=145)	Percentage
Vascular	36	24.8
Gastrointestinal	98	67.6
Thoracic and Pulmonary	46	31.7
Cardiac	8	5.5

Entry point for the source of infection	Sample Size (N=145)	Percentage
Cerebral	1	0.07
Urogenital	13	9
Otolaryngological	32	22.1
Oral and Dental	4	2.7
Blood	22	15.1
Skin	3	2.1

3.5. Etiological Diagnosis

Gastroenteritis was the most common cause among patients undergoing acute dialysis (46.7%) and chronic intermittent dialysis (77%), followed by urinary tract infections in the first group (13/45) and pneumonia in the second group (29/100) (Table 4).

Table 4. Distribution of patients presenting with an infectious syndrome by etiology according to the type of dialysis performed.

Etiology	Acute dialysis		Recurrent dialysis	
Type of dialysis	Sample Size N=45	Percentage	Sample Size N=100	Percentage
Gastroenteritis	21	46.7	77	77
Endocarditis	-	-	8	8
Pleurisy	-	-	25	25
Pneumonia	11	24.4	29	29
Tunnelitis	-	-	5	5
Thrombophlebitis	-	-	7	7
Other catheter-related infections	-	-	24	24
Meningitis	1	2.2	-	-
Sinusitis	-	-	27	27
Nasopharyngitis	-	-	11	11
Urinary tract infection	13	28.9	-	-
Post-injection abscess	-	-	7	7
Dental abscess	-	-	2	2
Malaria	10	22.2	3	3

3.6. Diagnostic Tests

All patients underwent a thick smear; only 9% had a positive result. The positivity rate for chest X-rays was 77%. For blood cultures, the positivity rate was (21/53), or 39% (Table 5).

Table 5. Distribution of patients presenting with an infectious syndrome according to laboratory tests and their diagnostic value.

Tests Requested	Performed	Diagnostic Value
Blood culture (n=98)	53 (54.1%)	21 (39.6%)
Urine cytology (n=67)	64 (95.5%)	13 (20.3%)
Stool culture (n=98)	47 (47.9%)	17 (36.2%)
Catheter tip culture (n=36)	33 (91.7%)	22 (66.7%)

Tests Requested	Performed	Diagnostic Value
CSF analysis (n=1)	1 (100%)	1 (100%)
Sputum (n=52)	52 (100%)	0
Gastric intubation (n=13)	13 (100%)	0
Biological fluid analysis (n=102)	102 (100%)	63 (61.8%)
Thick smear (n=145)	145 (100%)	13 (9%)
Chest X-ray (n=60)	48 (80%)	37 (77.1%)
Cardiac ultrasound (n=52)	36 (69.2%)	8 (22.2%)
Abdominal ultrasound (n=95)	95 (100%)	11 (11.6%)

3.7. Isolated Microorganisms

The most common microorganisms found in patients undergoing acute dialysis were Streptococcus (35%) and Staphylococcus (29%). In chronic intermittent dialysis, E. coli accounted for 63% and Staphylococcus for 25% (Table 6).

Table 6. Distribution of patients according to isolated microbial pathogens based on the type of dialysis performed.

Isolated microbial pathogens	Acute dialysis (n=45)		Recurrent dialysis (n=100)	
Type of dialysis	Sample Size	Percentage	Sample Size	Percentage
Klebsiella pneumonia	-	-	25	25
Streptococcus dore	16	35.5	7	7
Burkholderia cepaci	-	-	2	2
Proteus mirabilis	-	-	3	3
Staphylococcus aureus	13	28.9	19	19
Enterococcus faecalis	-	-	11	11
Plasmodium falciparum	10	22.2	3	3
Escherichia coli	6	13.3	63	63

3.8. Treatment and Clinical Course

More than 89% of our patients received two antibiotics concurrently. Third-generation ceftriaxone was the most commonly prescribed antibiotic (100%). The mortality rate was 8.3%.

Table 7. Distribution of Patients by Treatment and Clinical Course.

Number of antibiotics	Number	percentage
Monotherapy	15	10.3
Combination therapy	130	89.7

Number of antibiotics	Number	percentage
Prescribed antibiotics		
Céphalosporine 3G	145	100
Amoxicilline +Acide clavulanique	55	37.9
Erythromycine 500 mg	23	15.9
Rovamycine 3M	16	11
Ciprofloxacin 500 mg	98	67.6
Gentamycine 80 mg	11	7.6
Imipénème 0,5/1g	42	29
Metronidazole perfusable 500 mg	98	67.6
Vancomycine 500 mg	10	6.9

Number of antibiotics	Number	percentage
Ofloxacin 200 mg	33	22.7
Tazobactam+Piperaciline 1/125 mg	11	7.6
Artésunate 60 mg injectable	13	9
Clinical Course		
Favorable	133	91.7
Death	12	8.3

4. Discussion

4.1. Prevalence

Among the 386 hemodialysis patients, 145 had experienced at least one infectious episode during the study period, representing a prevalence of 37.5%. This rate is lower than that observed in studies conducted in France (39%) and the United States (42.4%) [7, 6]. This difference in prevalence may be explained by the fact that our study was single-center and had a short data collection period.

4.2. Sociodemographic Characteristics

Our patients had a mean age of 46.65 ± 15.33 years, with ages ranging from 14 to 80 years; the 30–44 age group was the most common, accounting for 32% of the total. Our results are comparable to those of AHOU S [13] et al. in Benin in 2019, who found in their study a mean age of 47.9 ± 4.3 years, with extremes ranging from 16 to 84 years, and in which the 30–50 age group was strongly represented. Our results differ from those of Birlutin V et al. [14], who found an average age of 65.47 ± 17.07 years. This difference may be related to the recruitment method, which can vary from one study to another.

Males were overrepresented in our series, accounting for 56% of the participants, with a male-to-female sex ratio of 1.27. This observation was also noted in the study by Birlutin V et al. [14]. Nearly 58% had not attended school, 87% lived in urban areas, and 60% had a low socioeconomic status.

4.3. Clinical Signs

The most common general signs were fever (94%) and chills (29%). Low back pain (93%), dyspnea (90%), pruritus (86%), edema (85%), abdominal pain (76%), cough (71%), vomiting (72%), burning during urination, and anuria (67%) were the most common functional signs. This is consistent with the findings of Birlutin V et al., who reported fever, chills, dyspnea, cough, and cardiac, gastrointestinal, cutaneous, urinary, and neurological manifestations [14].

The most commonly used access site was the femoral artery, used in 35% of cases, followed by a tunneled catheter in 30% of cases.

Our data are similar to those of Tall LA et al. [15] in Senegal in 2016, in a study on the prevalence of infections among chronic hemodialysis patients at the hemodialysis unit of the Aristide le Dantec University Hospital, who also reported that the femoral access (41%) was the most commonly used, followed by the tunneled catheter (33%) [16]. This may be explained by the fact that most patients begin their first dialysis sessions with a femoral catheter.

4.4. Route of Entry

The site of initial infection was the gastrointestinal tract (67.6%), the pleural-pulmonary system (31.7%), and the vascular system (24.8%). The frequency of routes of entry may vary from one country to another and from one study to another. In Benin [13], the main sites of entry were ENT (69%) and gastrointestinal (72%). This high proportion of gastrointestinal infections is thought to be due to poor food hygiene.

4.5. Etiologies

There were 80 patients admitted for temporary dialysis due to acute kidney injury, of whom 45 presented with an infectious syndrome. Gastroenteritis was the most common cause (21/45); urinary tract infection (13/45); and pneumonia (11/45). Acute kidney injury (AKI) is a common and serious complication of pediatric sepsis, with a reported incidence ranging from approximately 25% to over 50% in critically ill children, depending on diagnostic criteria and disease severity [17–20].

Of 306 patients on chronic dialysis, 100 presented with an infectious syndrome. Among these, 77% had gastroenteritis; 29% had pneumonia; 27% had nasopharyngitis; and 24% had catheter-related cases. Our results are comparable to those of AHOU S et al. [13] in Cotonou in 2019, who found that severe malaria (70%) was the most common cause.

4.6. Contributions of Paraclinical Tests

During this period, tests were ordered to identify the source of infection and isolate the causative pathogen. Blood cultures were ordered for 98 patients; 54% underwent the test, and 39.6% of those tested positive. Stool cultures (98 test requests, 47.9% performed, and 36.2% positive); cytology (67 requests, 95.5% performed, and 20.3% positive); catheter tip culture (36 requests, 91.7% performed, and 66.7% positive); chest X-ray (60 requests, 80% performed, and 77.1% positive). Our results differ from those of Birlutin V et al. [14], who found, among 30 samples (81.2% positive cases), catheter culture (4 samples, 100% positive) and stool culture (8 samples collected, 12.5% positive cases). This difference may be explained by differences in methodology, on the one hand, but also by the low socioeconomic status of our patients, which may have limited their access to testing.

4.7. Isolated Pathogens

Of the 145 diagnosed cases of infectious syndrome, microbial culture isolated the following pathogens in order of frequency: *E. coli* 69/145 (47.6%); *Staphylococcus* 32/145 (22.1%); and *Streptococcus* 23/145 (16%). Our results differ from those reported elsewhere [14], where *Staphylococcus aureus* accounted for 25/145 (25.5%); *Klebsiella pneumoniae* 19/98 (19.4%) and *E. coli* 15/98 (15.3%). This discrepancy may be related to a number of factors, including inadequate laboratory facilities and multidrug resistance to antibiotics.

4.8. Treatment and Course of the Disease

In our study, dual antibiotic therapy accounted for 89%, followed by ciprofloxacin (IV or tablet) and metronidazole (IV or tablet). Antibiotic prescribing depends on several factors, including the site of infection, antibiotic susceptibility, and availability. Thus, in a Romanian study [14], 49 out of 56, or 87.5%, received at least one antibacterial agent. Thirty-six out of forty-nine received dual antibiotic therapy. The most frequently administered antibiotic was cephalosporin (25 out of 56, or 44.6%); fluoroquinolone (17 out of 56, or 30.4%). This difference may be explained by the ease of access to this drug, its availability, and its affordability for patients of low socioeconomic status.

5. Limitations

- 1) The low socioeconomic status of patients in relation to the high cost of additional tests;
- 2) Insufficient technical resources for paraclinical investigations to identify bacterial strains;
- 3) The cross-sectional nature of the study, which makes it difficult to describe disease progression.

6. Conclusion

Infections affect more than one-third of hemodialysis patients, particularly those on temporary dialysis, where infections are both a cause and a serious complication. Infections originating in the gastrointestinal tract are the most common, with gastroenteritis being the primary cause. The most commonly isolated microorganism in body fluids and cultures is *E. coli*. Three-fifths of hemodialysis patients with low monthly incomes were unable to undergo tests for the etiological diagnosis of their infection. Authorities should intervene to ensure medical coverage for hemodialysis patients and improve the technical capabilities of the country's bacteriology laboratories.

Abbreviations

AVF Arteriovenous Fistula

CVC Central Venous Catheter
HIV Human Immunodeficiency Virus
HD Hemodialysis
CSF Cerebrospinal Fluid
ENT Otolaryngology

Author Contributions

Fousseny Diakite: Conceptualization, Data curation, Formal Analysis, Methodology, Supervision, Validation, Visualization, Writing – original draft, Writing – review & editing

Ibrahima Bah: Methodology, Supervision, Validation, Visualization, Writing – original draft

Soriba Bangoura: Methodology, Supervision, Validation, Visualization, Writing – review & editing

Amadou Yaya Diallo: Methodology, Supervision, Validation, Visualization

Fatoumata Kaba: Validation, Visualization

Fara Andre Sandouno: Validation, Visualization

Alseny Mariame Camara: Validation, Visualization

Mamadou Malal Diallo: Validation, Visualization

Kadiatou Mamadou Bobo Barry: Validation, Visualization

Mohamed Lamine Tegui Camara: Validation, Visualization

Damaris Yawa Leno: Validation, Visualization

Alpha Oumar Bah: Investigation

Conflicts of Interest

The authors declare no conflicts of interest.

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